

***Directional Antenna System
For
KCTL, Westminster, Colorado***

March 3, 2003

Electronics Research Inc. is providing a custom fabricated multiplexed directional antenna system that is specially designed to meet the FCC requirements and the general needs of radio station KCTL.

The antenna is the ERI model 1082-8CP-DA configuration. The circular polarized system consists of eight 92" spaced bays using two driven circular polarized radiating elements per bay. The antenna was tested on a 60" face ERI tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 93.3 megahertz, which is the center of the FM broadcast channel assigned to KCTL.

The other FM stations that will be transmitting from this directional antenna are KDJM @ 92.5 MHz, KFMD @ 95.7 MHz, KRFX @ 103.5 MHz, KALC @ 105.9 MHz and KBPI @ 106.7 MHz.

Pattern measurements were made on a sixty-acre antenna pattern range that is owned and operated by Electronics Research, Inc. The tests were performed under the direction of Thomas B. Silliman, president of Electronics Research, Inc. Mr. Silliman has the Bachelor of Electrical Engineering and the Master of Electrical Engineering degrees from Cornell University and is a registered professional engineer in the states of Indiana, Maryland and Minnesota.

Directional Antenna System For KCTL, Westminster, Colorado

(Continued)

DESCRIPTION OF THE TEST PROCEDURE

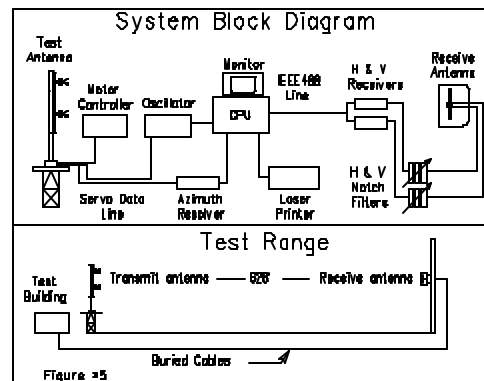
The test antenna consisted of four bay levels of the circular polarized system. The elements and brackets that were used in this test are the actual components that will be supplied with the antenna. The lines were properly grounded during all tests.

The power distribution and phase relationship to the antenna elements was adjusted in order to achieve the directional radiation patterns for both horizontal and vertical polarization components.

The proof-of-performance was accomplished using a 60" face ERI tower with identical dimension and configuration including all braces, ladders, conduits, coaxial lines and other appurtenances that are included in the actual aperture at which the antenna will be installed. The structure was erected vertically on a turntable mounted on a non-metallic building with the antenna centered vertically on the structure, making the center of radiation of the test approximately 30 feet above ground. The turntable is equipped with a motor drive and azimuth indicating mechanism, resolution of this azimuth measuring device is one-tenth of a degree.

The antenna under test was operated in the transmitting mode and fed from a Wavetek Model 3000 signal generator. The frequency of the signal source was set at 93.3 MHz and was constantly monitored by an Anritsu Model ML521B measuring receiver.

A broad-band horizontal and vertical dipole system, located approximately 628 feet from the test antenna, was used to receive the emitted test signals. The dipole system was mounted at the same height above terrain as the center of the antenna under test. The signals received by the dipole system were fed to the test building by way of two buried Heliax cables to an Anritsu Model ML521B measuring receiver.



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(Continued)

This data was interfaced to a Hewlett-Packard Laser Jet 4P printer by means of a Pentium computer system. Relative field strength was plotted as a function of azimuth.

The measurements were performed by rotating the test antenna in a counter-clockwise direction and plotting the received signal on polar coordinated graph paper in a clockwise direction. Both horizontal and vertical components were recorded separately.

CONCLUSIONS

The circular polarized system consists of eight 92" spaced bays using two driven circular polarized radiating elements per bay. The power distribution and phase relationship will be fixed when antenna is manufactured. Proper maintenance of the elements should be all that is required to maintain the pattern in adjustment.

The 1082-8CP-DA array is to be mounted on the 60" face ERI tower at a bearing of North 51 degrees East. Blue prints provided with the antenna will show the proper antenna orientation alignment. The antenna alignment procedure should be directed by a licensed surveyor as prescribed by the FCC.

Figure #1 represents the maximum value of either the horizontal or vertical component at any azimuth. The measured horizontal plane relative field pattern, for both the horizontal and vertical polarization components, is shown on Figure #2 attached. A calculated vertical plane relative field pattern is shown on Figure #3A attached. The power in the maximum will reach 100 kilowatts (20.00 dBk).

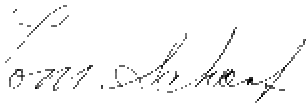
The RMS of the vertically polarized horizontal plane component does not exceed the RMS of the horizontally polarized horizontal plane component.

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(Continued)

The directional antenna should not be mounted on the top of an antenna tower that includes a top-mounted platform larger than the cross-sectional area of the tower in the horizontal plane. No obstructions other than those that are specified by the blue prints supplied with the antenna are to be mounted within 75 ft. horizontally of the system. The vertical distance to the nearest obstruction should be a minimum of 10 ft. from the directional antenna. Metallic guy wires should be a minimum distance of forty feet horizontally from the antenna.

ELECTRONICS RESEARCH, INC.

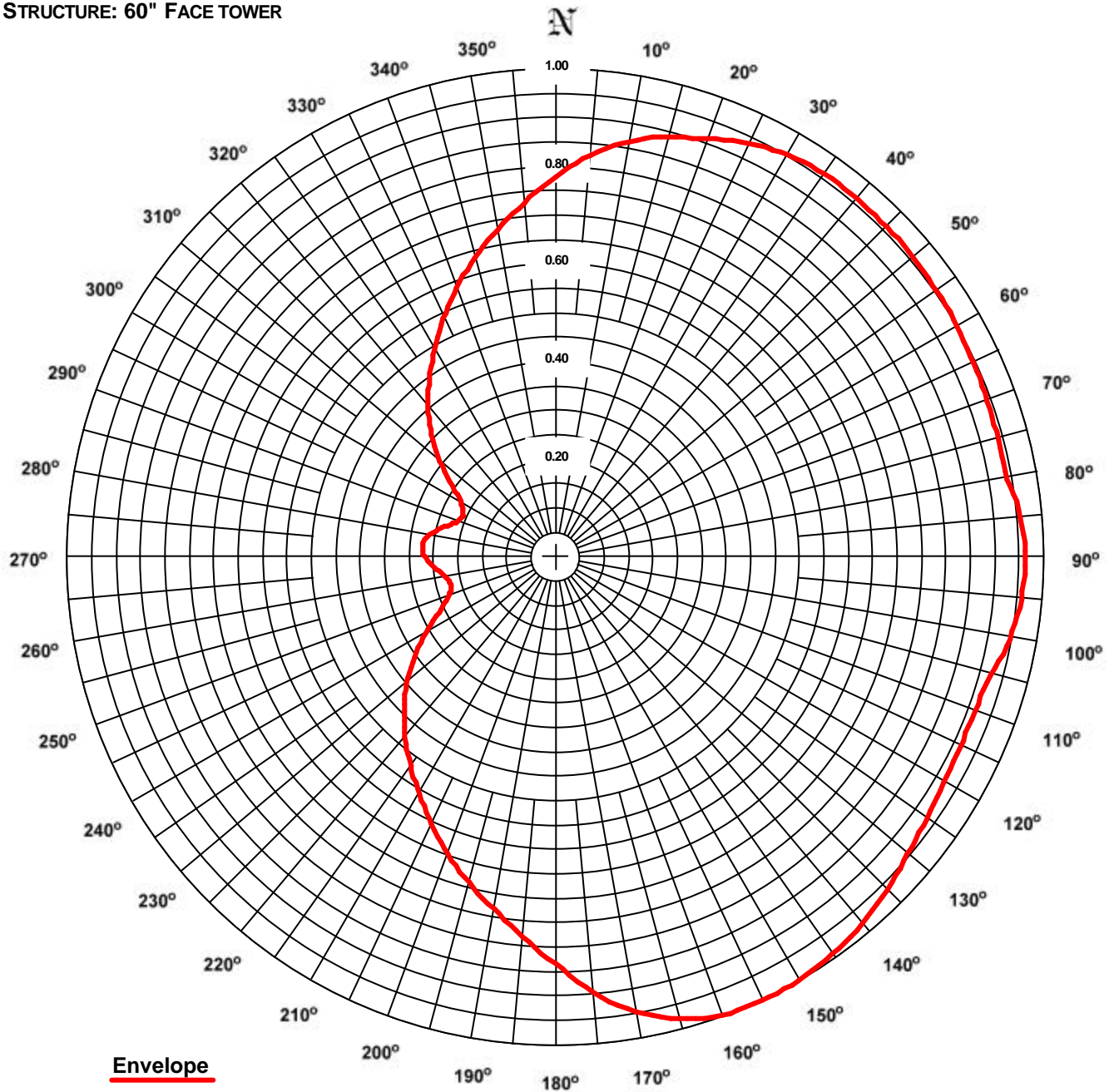
A handwritten signature in cursive script, appearing to read "L. D. Schaefer".

ERI® *Horizontal Plane Relative Field Pattern*

Electronics Research, Inc. 7777 Gardner Rd. Chandler, In 47610 Phone (812) 925-6000 Fax (812) 925-4030 <http://www.eriinc.com/>

FIGURE: 1
STATION: KCTL
LOCATION: WESTMINSTER, CO.
ANTENNA TYPE: 1082-8CP-DA
STRUCTURE: 60" FACE TOWER

DATE: 3/1/03
FREQUENCY: 93.3 MHz
ORIENTATION: 51° TRUE
MOUNTING: CUSTOM



RMS: 0.745
Maximum: 1.000 @ 153° True
Minimum: 0.209 @ 295° True

COMMENTS: COMPOSITE PATTERN: THIS PATTERN SHOWS THE MAXIMUM OF EITHER THE H OR V AZIMUTH VALUES.

ERI[®] *Horizontal Plane Relative Field List*

Electronics Research, Inc. 7777 Gardner Rd. Chandler, In 47610 Phone (812) 925-6000 Fax (812) 925-4030 <http://www.eriinc.com>

Station: KCTL
Location: Westminster, CO.
Frequency: 93.3 MHz

Antenna: 1082-8CP-DA
Orientation: 51° True
Tower: 60" Face tower

Figure: 1
Date: 3/1/03
Reference: kctl1m.fig

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.782	61.15	17.86	Vertical	180°	0.830	68.90	18.38	Vertical
5°	0.830	68.89	18.38	Vertical	185°	0.778	60.51	17.82	Vertical
10°	0.868	75.27	18.77	Vertical	190°	0.729	53.14	17.25	Vertical
15°	0.895	80.05	19.03	Vertical	195°	0.687	47.17	16.74	Vertical
20°	0.915	83.71	19.23	Horizontal	200°	0.645	41.63	16.19	Vertical
25°	0.939	88.21	19.46	Horizontal	205°	0.601	36.08	15.57	Vertical
30°	0.955	91.17	19.60	Horizontal	210°	0.558	31.09	14.93	Vertical
35°	0.962	92.50	19.66	Horizontal	215°	0.518	26.79	14.28	Vertical
40°	0.962	92.49	19.66	Horizontal	220°	0.480	23.02	13.62	Vertical
45°	0.960	92.24	19.65	Horizontal	225°	0.439	19.30	12.85	Vertical
50°	0.958	91.81	19.63	Horizontal	230°	0.398	15.87	12.01	Vertical
55°	0.955	91.21	19.60	Horizontal	235°	0.352	12.41	10.94	Vertical
60°	0.951	90.43	19.56	Horizontal	240°	0.307	9.42	9.74	Vertical
65°	0.946	89.54	19.52	Horizontal	245°	0.264	6.96	8.42	Vertical
70°	0.942	88.80	19.48	Horizontal	250°	0.235	5.50	7.41	Vertical
75°	0.939	88.24	19.46	Horizontal	255°	0.222	4.91	6.91	Vertical
80°	0.941	88.47	19.47	Vertical	260°	0.226	5.12	7.09	Vertical
85°	0.957	91.56	19.62	Vertical	265°	0.245	5.99	7.78	Vertical
90°	0.963	92.73	19.67	Vertical	270°	0.266	7.06	8.49	Vertical
95°	0.958	91.79	19.63	Vertical	275°	0.274	7.49	8.75	Vertical
100°	0.945	89.31	19.51	Vertical	280°	0.265	7.02	8.46	Vertical
105°	0.924	85.36	19.31	Vertical	285°	0.241	5.82	7.65	Vertical
110°	0.915	83.68	19.23	Horizontal	290°	0.218	4.74	6.75	Vertical
115°	0.915	83.64	19.22	Horizontal	295°	0.209	4.36	6.39	Vertical
120°	0.919	84.50	19.27	Horizontal	300°	0.222	4.92	6.92	Vertical
125°	0.929	86.21	19.36	Horizontal	305°	0.257	6.60	8.20	Vertical
130°	0.942	88.83	19.49	Horizontal	310°	0.309	9.56	9.81	Vertical
135°	0.961	92.33	19.65	Horizontal	315°	0.358	12.80	11.07	Vertical
140°	0.978	95.58	19.80	Horizontal	320°	0.405	16.42	12.15	Vertical
145°	0.990	97.96	19.91	Horizontal	325°	0.450	20.21	13.06	Vertical
150°	0.998	99.66	19.99	Horizontal	330°	0.495	24.52	13.90	Vertical
155°	1.000	100.00	20.00	Horizontal	335°	0.542	29.40	14.68	Vertical
160°	0.996	99.24	19.97	Horizontal	340°	0.591	34.95	15.43	Vertical
165°	0.977	95.51	19.80	Horizontal	345°	0.638	40.66	16.09	Vertical
170°	0.943	88.85	19.49	Horizontal	350°	0.685	46.96	16.72	Vertical
175°	0.892	79.60	19.01	Horizontal	355°	0.732	53.56	17.29	Vertical

Polarization:
Maximum Field:
Minimum Field:
RMS:
Maximum ERP:
Maximum Power Gain:

Envelope
1.000 @ 153° True
0.209 @ 295° True
0.745
100.000 kW
6.745 (8.290 dB)

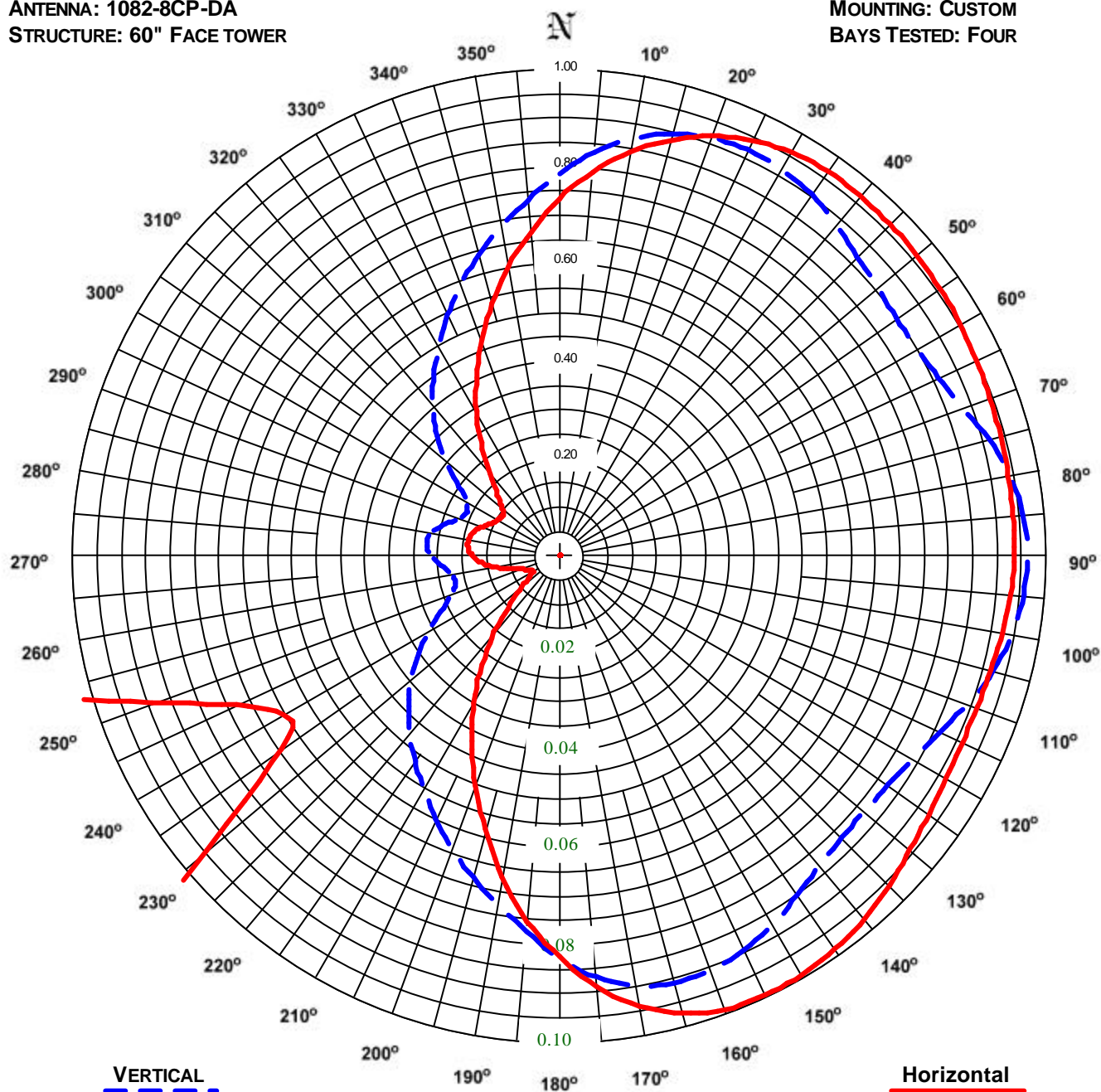
Total Input Power: 14.826 kW

ERI® *Horizontal Plane Relative Field Pattern*

Electronics Research, Inc. 7777 Gardner Rd. Chandler, In 47610 Phone (812) 925-6000 Fax (812) 925-4030 <http://www.eriinc.com/>

FIGURE NO: 2
STATION: KCTL
LOCATION: WESTMINSTER, CO.
ANTENNA: 1082-8CP-DA
STRUCTURE: 60" FACE TOWER

DATE: 3/1/03
FREQUENCY: 93.3 MHZ
ORIENTATION: 51° TRUE
MOUNTING: CUSTOM
BAYS TESTED: FOUR



RMS: 0.710
MAXIMUM: 0.963 @ 90° TRUE
MINIMUM: 0.209 @ 295° TRUE

10X Scale

RMS: 0.710
Maximum: 1.000 @ 153° True
Minimum: 0.065 @ 238° True

COMMENTS: MEASURED PATTERNS OF THE HORIZONTAL AND VERTICAL COMPONENTS.

ERI[®] Horizontal Plane Relative Field List

Electronics Research, Inc. 7777 Gardner Rd. Chandler, In 47610 Phone (812) 925-6000 Fax (812) 925-4030 <http://www.eriinc.com>

Station: KCTL

Location: Westminster, CO.

Frequency: 93.3 MHz

Antenna: 1082-8CP-DA

Orientation: 51° True

Tower: 60" Face tower

Figure: 2

Date: 3/1/03

Reference: kctl1m.fig

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.731	53.44	17.28	0.782	61.15	17.86	180°	0.826	68.22	18.34	0.830	68.90	18.38
5°	0.790	62.41	17.95	0.830	68.89	18.38	185°	0.757	57.29	17.58	0.778	60.51	17.82
10°	0.840	70.61	18.49	0.868	75.27	18.77	190°	0.675	45.57	16.59	0.729	53.14	17.25
15°	0.882	77.78	18.91	0.895	80.05	19.03	195°	0.586	34.32	15.36	0.687	47.17	16.74
20°	0.915	83.71	19.23	0.911	83.07	19.19	200°	0.506	25.58	14.08	0.645	41.63	16.19
25°	0.939	88.21	19.46	0.918	84.22	19.25	205°	0.424	17.95	12.54	0.601	36.08	15.57
30°	0.955	91.17	19.60	0.914	83.49	19.22	210°	0.351	12.29	10.89	0.558	31.09	14.93
35°	0.962	92.50	19.66	0.903	81.56	19.11	215°	0.277	7.67	8.85	0.518	26.79	14.28
40°	0.962	92.49	19.66	0.886	78.48	18.95	220°	0.208	4.32	6.35	0.480	23.02	13.62
45°	0.960	92.24	19.65	0.866	75.04	18.75	225°	0.141	1.98	2.97	0.439	19.30	12.85
50°	0.958	91.81	19.63	0.853	72.76	18.62	230°	0.095	0.90	-0.46	0.398	15.87	12.01
55°	0.955	91.21	19.60	0.846	71.63	18.55	235°	0.070	0.49	-3.14	0.352	12.41	10.94
60°	0.951	90.43	19.56	0.848	71.91	18.57	240°	0.066	0.43	-3.66	0.307	9.42	9.74
65°	0.946	89.54	19.52	0.860	73.99	18.69	245°	0.073	0.54	-2.68	0.264	6.96	8.42
70°	0.942	88.80	19.48	0.883	77.89	18.91	250°	0.089	0.79	-1.01	0.235	5.50	7.41
75°	0.939	88.24	19.46	0.914	83.57	19.22	255°	0.113	1.27	1.02	0.222	4.91	6.91
80°	0.937	87.86	19.44	0.941	88.47	19.47	260°	0.142	2.01	3.04	0.226	5.12	7.09
85°	0.936	87.65	19.43	0.957	91.56	19.62	265°	0.165	2.73	4.37	0.245	5.99	7.78
90°	0.936	87.54	19.42	0.963	92.73	19.67	270°	0.181	3.27	5.15	0.266	7.06	8.49
95°	0.932	86.93	19.39	0.958	91.79	19.63	275°	0.189	3.56	5.52	0.274	7.49	8.75
100°	0.926	85.72	19.33	0.945	89.31	19.51	280°	0.188	3.54	5.49	0.265	7.02	8.46
105°	0.919	84.40	19.26	0.924	85.36	19.31	285°	0.181	3.27	5.14	0.241	5.82	7.65
110°	0.915	83.68	19.23	0.895	80.03	19.03	290°	0.167	2.80	4.47	0.218	4.74	6.75
115°	0.915	83.64	19.22	0.864	74.61	18.73	295°	0.152	2.32	3.66	0.209	4.36	6.39
120°	0.919	84.50	19.27	0.841	70.72	18.50	300°	0.144	2.07	3.15	0.222	4.92	6.92
125°	0.929	86.21	19.36	0.826	68.28	18.34	305°	0.142	2.01	3.04	0.257	6.60	8.20
130°	0.942	88.83	19.49	0.820	67.21	18.27	310°	0.155	2.39	3.79	0.309	9.56	9.81
135°	0.961	92.33	19.65	0.823	67.69	18.30	315°	0.183	3.36	5.26	0.358	12.80	11.07
140°	0.978	95.58	19.80	0.834	69.56	18.42	320°	0.228	5.19	7.15	0.405	16.42	12.15
145°	0.990	97.96	19.91	0.853	72.84	18.62	325°	0.280	7.83	8.94	0.450	20.21	13.06
150°	0.998	99.66	19.99	0.879	77.25	18.88	330°	0.342	11.69	10.68	0.495	24.52	13.90
155°	1.000	100.00	20.00	0.898	80.70	19.07	335°	0.402	16.15	12.08	0.542	29.40	14.68
160°	0.996	99.24	19.97	0.910	82.75	19.18	340°	0.469	21.97	13.42	0.591	34.95	15.43
165°	0.977	95.51	19.80	0.912	83.23	19.20	345°	0.533	28.46	14.54	0.638	40.66	16.09
170°	0.943	88.85	19.49	0.900	81.02	19.09	350°	0.602	36.20	15.59	0.685	46.96	16.72
175°	0.892	79.60	19.01	0.873	76.16	18.82	355°	0.665	44.25	16.46	0.732	53.56	17.29

Polarization:

Maximum Field:

Minimum Field:

RMS:

Maximum ERP:

Maximum Power Gain:

Horizontal

1.000 @ 153° True

0.065 @ 238° True

0.710

100.000 kW

6.745 (8.290 dB)

Vertical

0.963 @ 90° True

0.209 @ 295° True

0.710

92.730 kW

6.254 (7.962 dB)

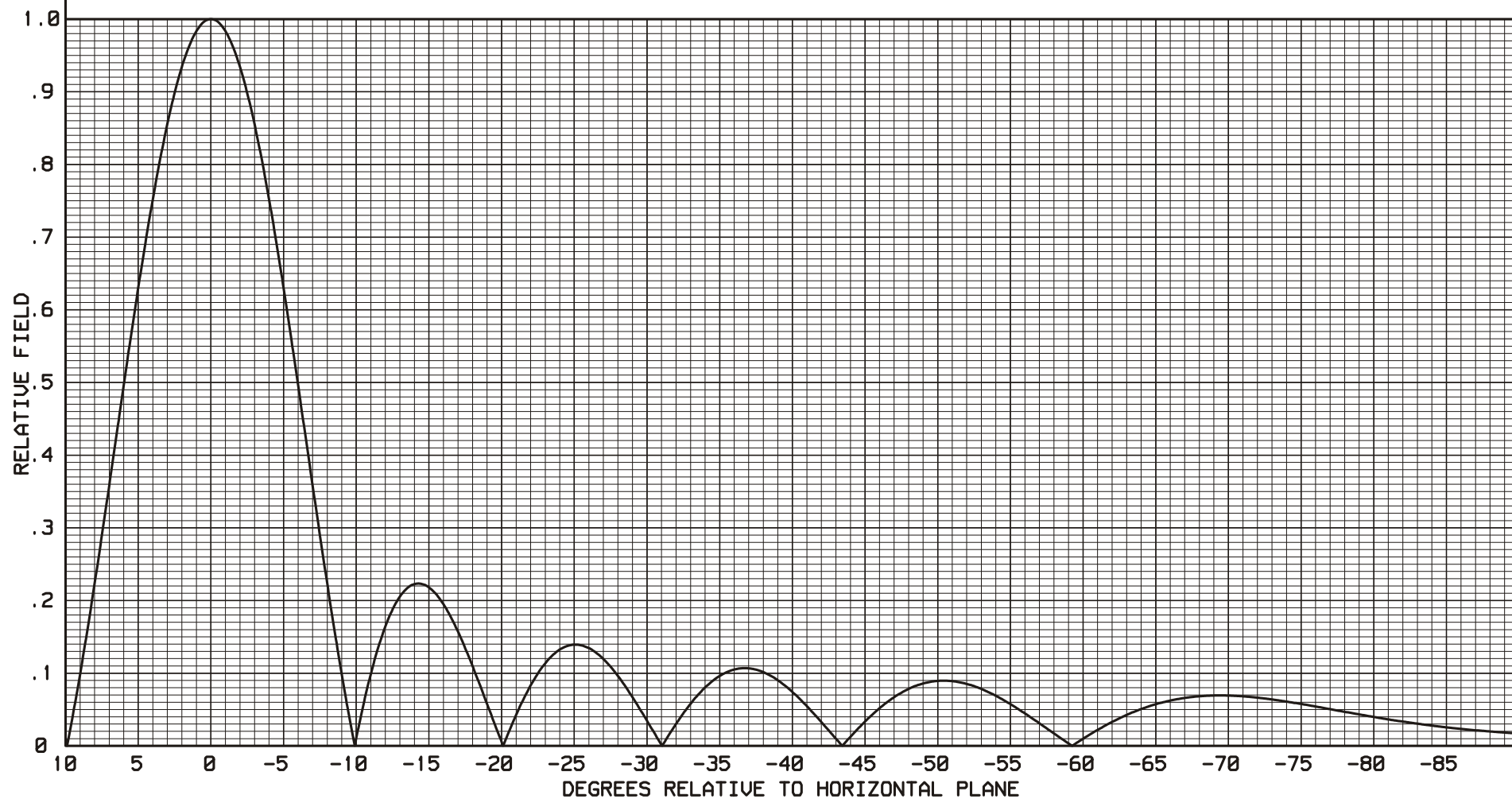
Total Input Power: 14.826 kW

ELECTRONICS RESEARCH, INC.
7777 GARDNER ROAD
CHANDLER, IN. 47610

FIGURE 3A

----THEORETICAL----
VERTICAL PLANE RELATIVE FIELD
ERI TYPE 1082-8CP-DA ANTENNA
0 DEGREE BEAM TILT
0 PERCENT NULL FILL

93.3 MHz.
BAY SPACING
92.00 INCHES



Directional Antenna System for KCTL, Westminster, Colorado

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	1082-8CP-DA
Frequency:	93.3 MHz
Number of Bays:	eight

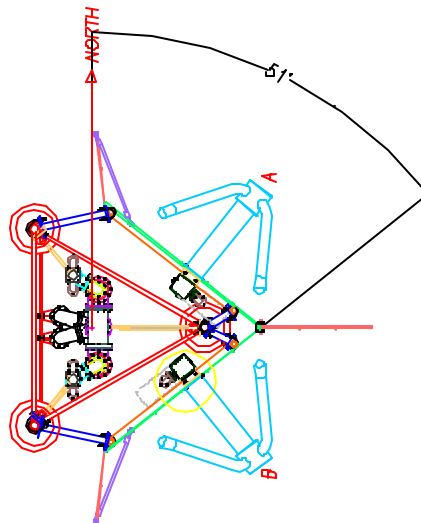
MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	61.33 ft
Orientation:	51° true
Input flange to the antenna	6 1/8 inch female

ELECTRICAL SPECIFICATIONS

(For directional use)

Maximum horizontal ERP:	100 kW (20.00 dBk)
Horizontal maximum power gain:	6.745 (8.290 dB)
Maximum vertical ERP:	92.730 kW (19.672 dBk)
Vertical maximum power gain:	6.254 (7.962 dB)
Total input power:	14.826 kW (11.710 dBk)



Directional Antenna System
For
KCTL, Westminster, Colorado

(Continued)

Four Bay Test Model
Of The Eight Bay Array

